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REVIEW

Conduct problems trajectories and psychosocial outcomes: a systematic review and meta-analysis

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Abstract There is increasing evidence that youth who follow the early onset persistent (EOP), adolescent-onset (AO) and childhood-limited (CL) trajectories of conduct problems show varying patterns of health, mental health, educational, and social outcomes in adulthood. However, there has been no systematic review and meta-analysis on outcomes associated with different conduct problems trajectories. We systematically reviewed the literature of longitudinal studies considering outcomes of three conduct problems trajectories: EOP, AO, and CL compared with individuals with low levels of conduct problems (low). We performed a series of meta-analyses comparing each trajectory to the low group for eight different outcomes in early adulthood or later. Thirteen studies met our inclusion criteria. Outcomes were mental health (depression), cannabis use, alcohol use, self-reported aggression, official records of antisocial behaviour, poor general health, poor education, and poor employment. Overall, EOP individuals showed significant higher risk of poor outcome followed by AO individuals, CL individuals, and finally participants in the low group. All conduct problems trajectories showed higher risk of poor psychosocial

outcomes compared to the low group, but the magnitude of risk differed across trajectories, with a general trend for the EOP to perform significantly worse, followed by the AO and CL. Early intervention is recommended across domains to maximise likelihood of desistance from antisocial behaviour and improvement on several psychosocial outcomes.

Keywords Conduct problems · Trajectories · Meta-analysis · Longitudinal · Psychosocial outcomes

Abbreviations

CD	Conduct disorder
SDQ	Strengths and Difficulties Questionnaire
DAWBA	Development and well being assessment
EOP	Early onset persistent
AO	Adolescent-onset
AL	Adolescence-limited
CL	Childhood-limited
CBCL	Child behaviour checklist

Introduction

Conduct problems include disobeying rules, aggression, property destruction, stealing, and bullying [1]. An important taxonomical difference was made over two decades ago [2] between life-course persistent (LCP), also referred to as early onset persistent (EOP) subtype, with onset in childhood, and adolescent-limited or adolescent-onset (AO), with an onset in adolescence. The EOP was thought to be associated with predisposing familial, neuropsychological deficits, and temperamental hyperactivity, which could interact with environmental factors to potentiate more severe and persistent behavioural problems and antisocial behaviour. Those with onset in adolescence were thought to engage

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in behavioural problems (of less aggressive nature) mainly through association with delinquent peers, and/or seeking social status through delinquent activities. They were thought to be likely to desist from antisocial behaviour during late adolescence/early adulthood as they transition into adult roles and responsibilities [3], but more recent research has shown that in some cases, they continue to engage in undetected crimes and show substance use and internalising difficulties beyond adolescence [4, 5].

In recent years, researchers have begun to use complex data analytic techniques, such as growth mixture models, to map heterogeneity in the development of conduct disorders and other types of psychopathology [6]. Mixture modelling is a technique that allows for (a) the estimation of multiple trajectories, (b) describing longitudinal patterns of change specific to each trajectory, and (c) allows for investigating risk factors, such that each trajectory may have distinct developmental correlates. As with most statistical techniques, however, mixture modelling has certain limitations, which include difficulty deciding the optimal number of trajectories, as it is an exploratory technique, and also the relevance of risk factor (i.e., covariates) as bias in parameter estimates is not uncommon to these sorts of models [7, 8]. Thanks to such approaches, a third trajectory was identified, called childhood-limited (CL) subtype. These individuals also show high levels of conduct problems early in their life-course and several risk factors, but appear to remit in their conduct problems, such that by adolescence or adulthood, they engage in near-zero levels of these behaviours [4, 9, 10]. The EOP, AO, and CL trajectories have repeatedly been identified in longitudinal studies that seek to investigate the risk factors and consequences of conduct problems and antisocial behaviour across life [11].

EOP individuals experience multiple risk factors, which over the years may negatively impact their psychological and physical health. Early risk factors such as harsh parenting, maternal anxiety, parental instability, and partner cruelty to mother but also mother and child diet have shown to be associated with the EOP trajectory [12, 13], as well as adolescence correlates such as peer problems, emotional difficulties, and high risk of affiliating with deviant peers [14, 15]. Early risk factors also account for AO individuals, particularly parental instability [16], low IQ and under controlled temperament [17]. Concomitant risk factors in adolescents with conduct problems include high-risk sexual behaviour, high levels of academic difficulties, and substance use [18, 19]. Regarding CL individuals, previous research showed that risk factors are similar to those seen in EOP such as maltreatment, family conflict, and maternal maladjustment [4, 20] but present with lower levels compared to EOP. CL individuals in adolescence have normal levels of conduct problems and some studies showed remission of peer rejection and emotional difficulties, suggesting that this group

has relatively normal outcomes in adolescence [21]. Others, however, showed problems in a number of areas such as higher rates of teenage parenthood in females and lower academic achievement compared to low conduct problems individuals (or low) [22].

These risk factors and behaviours may well have a direct impact on an individual's health, but more complex processes have also been hypothesised to describe how the wear and tear of conduct problems individuals' life-styles have an impact on multiple domains at later stages of their life: Caspi and Moffitt [23] have argued that the process of cumulative continuity operates, such that risk factors at one time-point have an impact on later adaptation. Developmental "snares" such as incarceration, early pregnancy, or addiction to substances may tie conduct problems individuals to persistent patterns of maladaptive life-styles and high levels of stress which may result in multiple problems in the transition to adulthood and/or later.

Conduct problems trajectory studies have begun to suggest that this wear and tear can result in mental and physical health problems in early adulthood and adulthood, especially for the EOP and AO individuals. For example, Odgers et al. [17] investigated differential health burden at age 32 by conduct problems subtypes in a sample of 526 males. The authors observed that those in the EOP trajectory were at significantly higher risk of mental health difficulties, engaging in violent acts, abusing substances, and physical health problems (i.e., serious injuries and chronic bronchitis) compared to individuals with low levels of conduct problems. AO also showed higher risk on most measures considered, but this was generally not as high as EOP. Although indistinguishable from EOP in terms of baseline symptoms of conduct problems, CL individuals did not show significantly higher risk of poor outcomes on most of the measures considered in this study. Similarly, Kretschmer et al. [24] found that EOP individuals were at higher risk compared to low conduct problems individuals on a number of outcomes including smoking and substance use, criminal and risky sexual behaviour, gambling, and mental health at age 18. Higher rates of risky sexual behaviour and substance use were observed in AO individuals. In the adjusted results, authors did not observe significantly higher risk in the CL group but concluded that CL individuals transition into young adulthood with levels of health and behaviour problems that are not as low as those observed in the low trajectory group. Other studies, however, found that CL individuals showed significantly higher risk of performing aggressive and rule-breaking behaviours, feeling withdrawn/depressed and having thought problems at age 17–20 compared to those in the low trajectory group [25].

In summary, the previous studies conducted in several countries on a range of outcomes of different conduct problems trajectories have generally found that EOP youth have

the highest risk of poor outcomes in early adulthood and adulthood [26]. However, results seem to be less clear regarding the AO and particularly CL groups. Literature reviews on developmental trajectories of antisocial behaviour and their outcomes have been conducted [11], but did not include a quantitative investigation and only considered females.

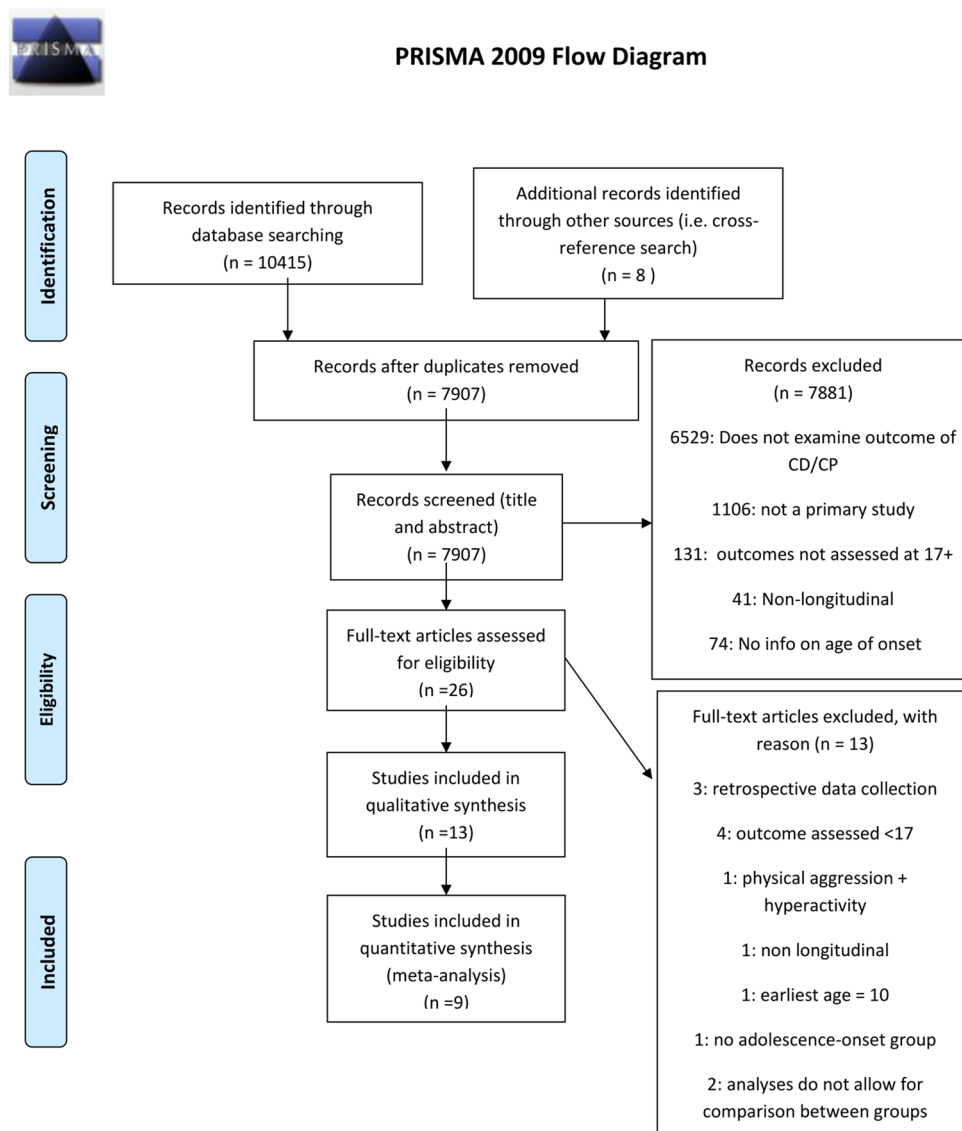
The aim of this work is to systematically review the literature regarding a range of health, mental health, educational, and social outcomes associated with conduct problems trajectories. Conducting a systematic review and quantitative meta-analysis represents a powerful way to summarise data in this field and clarify EOP individuals' outcomes and shed light on the outcomes of AO and CL individuals, which are less well understood. To our knowledge, this is the first systematic review and meta-analysis to investigate health, mental health, educational, and social outcomes, of different conduct problems trajectories.

Methods

This review was conducted and reported in accordance with the preferred reporting items for systematic reviews and meta-analyses (PRISMA) statement [27].

Initial searches were conducted on 26th May, 2015 with a follow-up search conducted on 26th August 2016. Searches were undertaken using PubMed (Medline) and PsycINFO as these were considered most relevant given the research question. EPPI Reviewer [28] was used to screen all the studies identified by the searches. Figure 1 shows the PRISMA flowchart, with details of included and excluded papers with reason. Details of the searches performed in Medline and PsycINFO can be found in [Appendix](#).

Fig. 1 Flow chart illustrating excluded and included articles



Study inclusion and exclusion criteria

We screened studies based on the following inclusion and exclusion criteria:

Inclusion criteria:

- Longitudinal studies that compared subtypes of conduct disorder/conduct problems based on age of onset (i.e., childhood vs adolescent-onset as defined by the DSM-IV which sets a cutoff at age 10);
- Studies where growth models were employed to compare outcomes of different trajectory groups of conduct disorder/conduct problems individuals;
- Studies where exposures (child and adolescent assessments) included formal clinical diagnoses of conduct disorder (CD) or validated epidemiological measures of significant behavioural problems associated with CD but without a formal diagnosis being present (aggressive, destructive, disruptive, deceitful behaviour, and violation of rules) from child, parent, or teacher reports;
- Studies where outcomes were assessed ≥ 17 years. This cutoff was considered appropriate given our interest not only in health and social but also educational outcomes.

Exclusion criteria:

- Cross-sectional studies in adulthood with retrospective recall of earlier behaviour problems (due to known problems with reporter bias and recall in these types of studies [29]);
- Intervention studies;
- non-longitudinal studies;
- studies with outcomes assessed at age < 17 ;
- studies where age of onset of conduct disorder/conduct problems is not specified or only one time-point of assessment is included;
- studies not reported in English.

Study selection

After removing all duplicates, all abstracts were screened. The full text was retrieved for studies not excluded based on the abstract. For all studies identified which met our inclusion criteria, we searched the reference list and all articles which cited the target paper for further studies relevant for our work. When necessary, contact was made with study authors to request full text or details regarding the paper. Two authors (LB and DH) contributed to the screening of the studies. Some discrepancies/uncertainties emerged and were related mainly to understanding whether the study in question included data before and after age 10, as well as

outcomes assessed at age 17 or later. These discrepancies/uncertainties were resolved by discussion.

Risk of bias in included studies

A modified version of the Newcastle–Ottawa scale [30] was used to perform quality assessments for the included studies. This assessed the representativeness of the conduct problems population and non-exposed population and the comparability of these samples, the reliability and validity of measurement variables, and attrition. Total scores range from zero to six. Quality data for included studies are shown in Table 1. For more details, a template is available in [Appendix](#).

Data extraction, collection, and quality

We developed a data extraction template which we applied across all included studies. This included: title and year of publication, assessment measurements, covariates, outcome measures, number of individuals in each trajectory, effect size, and country of provenance. The original data extraction table is available upon request.

Summary measures

We used odds ratios (ORs) as our main summary statistics to perform the meta-analyses. Where ORs were not available in the paper, they were calculated from available information (i.e., mean and standard deviation or mean and standard error) using the Campbell collaboration effect size calculator [31]. Where non-significant differences were reported, but information was insufficient to calculate ORs, we set ORs as equal to one, assuming total equivalence between conduct problems trajectories and the low group.

Where multiple papers were drawn from the same sample, we included only one study in the meta-analyses opting for the study with the largest number of outcomes considered.

Synthesis of results

To perform the meta-analyses, we mapped studies to type of outcome considered. The majority of the outcomes reported in the included studies mapped to eight domains: mental health (depression or depressive mood), cannabis use, alcohol use, self-reported aggression, criminal/antisocial behaviour (official records), poor general health, poor education, and poor employment outcome. Meta-analyses were performed for each of these outcome categories where at least three analyses were available. The number of studies included for each meta-analysis differed due to outcome variables considered in each study.

Data were analysed using STATA 13. We used random-effects meta-analyses to compute pooled effect sizes and

Table 1 Study characteristics and quality assessment

Author	Covariates	Age at first assessment	Ages at follow-up	Age at outcome	Country	Gender	Selection	Comparability	Attrition	Total
Alink and Egeland [35]	Authors report “the mediating effect of emerging adulthood adaptation”. However, the OR were obtained from unadjusted M and SD		5 6, 7, 8, 11		28 US	Mixed	★★★	☆☆	☆	★★★
Bor et al. [53]	No control variables or mediating factors mentioned		5	14	21 Australia	Mixed	★★★	☆☆	☆	★★★
Kretschmer et al. [24]	Family characteristic (SES marital status, maternal education, substance use during pregnancy), birth information (child weight gestational age, birth complications), child characteristics (language development, child temperament, mood at 24 months postpartum), child experiences (maternal mental health, maternal attitude towards child, child injury within first 4 years of life)		4 6 assessments from 4 to 13	17 years 9 months	UK (ALSPAC)	Mixed	★★★	★★	☆	★★★★★
Moffitt et al. [54]	No mention of covariates in the paper		5 5, 7, 9, 11, 13, 15, 18, 21		26 NZ (Dunedin)	Males	★★★	☆☆	★	★★★★★
Moffitt et al. [19]	No mention of covariates in the paper		5 5, 7, 9, 11, 13, 15		18 NZ (Dunedin)	Males	★★★	☆☆	★	★★★★★
Odgers et al. [4]	No mention of covariates in the paper		7 9, 11, 13, 15, 18, 21 and 26		32 NZ (Dunedin)	Mixed	★★★	★★	★	★★★★★

Table 1 (continued)

Author	Covariates	Age at first assessment	Ages at follow-up	Age at outcome	Country	Gender	Selection	Comparability	Attrition	Total
Odgers et al. [17]	No mention of covariates in the paper		7, 9, 11, 13, 15, 18, 21 and 26		32 NZ (Dunedin)	Males	★★★	★★	★	★★★★★
Moffitt et al. [45]	No mention of covariates in the paper	Grade 1 (6–7 years old)	Grades 2, 3, 6 and age 16		23 US	Mixed	★★★	☆☆	★	★★★★★
Xie et al. [22]	Authors controlled for ethnicity when comparing different trajectories	Grade 4 (9–10 years old)	Annual evaluations from grade 4 to grade 12	Grade 12 (18 years old)	US	Mixed	★★★	★★	★	★★★★★
Hayatbakhsh et al. [55]	SES, maternal marital status and quality, maternal mental health, maternal smoking, and illicit drug use, child internalising behaviour, and attention problems		5	14	21 Australia	Mixed	★★★	★★	★	★★★★★
Stringaris et al. [56]	Model 1: Gender and depression age 10 or 13 Model 2: Gender, family adversity index, age 7 reading, age 8 academic self-esteem		4, 7, 8, 10, 12, 13		18 UK (ALSPAC)	Mixed	★★☆	★★	☆	★★★
McGee et al. [57]	Maternal age entry, family SES, marital status, maternal depression, and anxiety		5	14	21 Australia	Mixed	★★★	★★	☆	★★★★★
Sentse et al. [25]	No mention of covariates in the paper	Between 5 and 8	6–9, 9–12, 12–15, 14–17	17–20	Belgium	Mixed	★★★	☆☆	☆	★★★

SES socioeconomic status, OR odds ratios, M mean, SD standard deviation, UK United Kingdom, NZ New Zealand, US United States, ALSPAC avon longitudinal study of parents and children

confidence intervals. Past research suggests that the random-effects model is preferable over fixed-effects models where there is a significant heterogeneity [32, 33] and allows for calculation of measures of heterogeneity across studies (I-square) for each meta-analysis. To test for significant differences in effect sizes across trajectories, we observed whether the confidence intervals for effect sizes overlapped; non-overlap was interpreted as a significant difference between effect sizes. This is a conservative estimate of significant differences [34] which is appropriate, given the multiple comparisons being made.

Results

We identified 13 studies which met our inclusion criteria with a total of 10,663 individuals (Table 1). All studies made use of three comparable trajectory groups of conduct problems onset and persistence/desistance: early onset persistent or life-course persistent (EOP); adolescent-onset or adolescent-limited or increasing (AO); childhood-limited or childhood-desisting (CL); a fourth trajectory, the low conduct problems (Low) was used as the reference category. Only one study did not include the CL trajectory [35].

Table 1 describes each study included in the review, including a quality assessment based on a modified version of the Newcastle–Ottawa Scale. At the first data collection point, age across the studies ranged from four to nine with an unweighted mean across all studies of 5.53 years. The age at which outcomes were assessed ranged across studies from 17 to 32 years, with an unweighted mean age of 22.5 years. Three of the thirteen studies selected were conducted in the US, three in Australia, four in New Zealand, two in the UK, and one in Belgium. Three studies included a male-only sample, while all the others included a mixed-gender sample. In general, the quality of the studies was moderate (average of four out of six stars). More specifically, we observed good study quality in terms of the representativeness of the study population and ascertainment of exposure. This last aspect in particular is important to determine the overall reliability of a study. Attrition was high in a number of cases. This was somewhat expected due to the large time interval that characterised most of our studies.

The measures used in each study to assess conduct problems in childhood and adolescence and measures of adult outcomes are shown in Appendix, with Table 2 showing health and substance use outcomes and Table 3 showing conduct, educational, and social outcomes.

Outcomes of the meta-analyses are shown in Figs. 2 and 3 and summarized in Appendix (Table 4). Figure 2 shows forest plots of individual and overall (pooled) ORs and I-square for each trajectory for health and substance use outcomes, with Fig. 3 showing the same for conduct,

educational and social outcomes. A summary table of data from these meta-analyses can be found in Appendix (Table 4).

Seven studies examined mental health outcomes, including but not limited to depressive feelings and clinical diagnosis of depression. The largest effect size was found for the EOP trajectory (pooled OR 2.24, 95% CI 1.67–3.01). The AO trajectory was also associated with significantly higher risk of depression/depressive mood in young adulthood (pooled OR 1.58, 95% CI 1.19–2.08). The CL trajectory was also associated with higher risk, but this finding was not significant (pooled OR 1.29, 95% CI 1.00–1.66).

Seven studies examined cannabis use. The largest effect size was observed in the AO trajectory (pooled OR 3.78, 95% CI 2.54–5.63). EOP individuals were also at higher risk of using cannabis in young adulthood (pooled OR 3.34, 95% CI 2.53–4.41). The CL trajectory was not significantly associated with higher risk of cannabis use (pooled OR 1.14, 95% CI 0.89–1.47).

Five studies examined alcohol use. Here, the largest effect size was observed for the EOP trajectory (pooled OR 1.85, 95% CI 1.04–3.28). AO participants were also at significantly higher risk of drinking excessive amounts of alcohol in young adulthood (pooled OR 1.72, 95% CI 1.23–2.41). CL individuals were not at higher risk of drinking excessive amount of alcohol in young adulthood (pooled OR 1.14, 95% CI 0.80–1.63).

Seven studies examined self-reported aggression. The largest effect size was observed for the EOP trajectory (pooled OR 5.40, 95% CI 2.80–10.43). AO individuals were also at significantly higher risk of self-reporting high levels of aggression in young adulthood (pooled OR 3.55, 95% CI 2.07–6.08). CL individuals were also at significantly higher risk of self-reporting high levels of aggression in young adulthood (pooled OR 1.75, 95% CI 1.21–2.53).

Six studies included official records of criminal behaviour. The largest effect size was observed for the EOP trajectory (pooled OR 3.18, 95% CI 1.73–5.85). AO individuals were also found to be at significantly higher risk of having an official record of involvement in criminal activity (pooled OR 2.29, 95% CI 1.43–3.67). For CL individuals, we observed a trend towards being more likely to have an official record of involvement in criminal activity, but this did not reach statistical significance (pooled OR 1.28, 95% CI 0.99–1.66).

Four studies examined general health outcomes. Here, the largest effect size was observed for the AO trajectory (pooled OR 2.38, 95% CI 1.25–4.53). Similarly, EOP individuals were found to be at significantly higher risk to report general health problems in young adulthood (pooled OR 2.35, 95% CI 1.48–3.73). CL individuals were not found to be at higher risk of reporting general health problems in young adulthood (pooled OR 1.36, 95% CI 0.89–2.10).

Table 2 Summary of health and substance use outcome measures

Author	Assessment measures	Mental health	General health	Cannabis use	Alcohol use
Alink and Egeland [35]	CBCL, Teacher Report Form (TRF) and Youth Self-Report (YSR), TRF				
Bor et al. [53]	CBCL (short form at age 5), while the Youth Self Report CBCL was used at age 14	Anxiety and depressive symptoms were assessed using the YASR anxiety/depression subscale. Scores exceeding one standard deviation above the mean were considered to represent "caseness". Delusional symptoms were assessed using the 21-item Peters Delusion Inventory (PDI-21). Questions are derived by the Present State Examination. Individuals were put into three categories: 0–3 items, 4–10 items, 11 or more items	General health problems: participants were asked whether they had been told by a doctor that they had a range of physical problems; participants were grouped as follows: no problems at all, one to three problems, four problems or more	Cannabis consumption: never used, every day, every few days, used it once or so, not used in the past month. Participants were then put into the following categories: never used, occasional users, and frequent users	Binge drinking: number of standard drinks drunk on a typical drinking occasion (+6 on a typical drinking occasion, 1–6, 0)
Kretschmer et al. [24]	Mother-reported conduct problems, using the "conduct problem" subscale of the SDQ. The sum score was dichotomised using the standard threshold of scores of 4 or more, yielding 6 binary indicators for the latent growth classes	Depression and anxiety measured using the clinical interview schedule-revised (CIS-R), a self-administered computerised interview that derives diagnoses based on ICD-10 criteria for depression and anxiety disorder (GAD, panic, phobia, social anxiety)	Risky sexual behaviour: respondents were asked how many sexual partners they had had in the last year and were assigned a score of one if they reported three or more different partners	Cannabis use: respondents completed the six-item cannabis abuse screen test asking about cannabis use in the previous 12 months. The sum score was derived by assigning one to the responses "fairly often" and "often" and 0 to the other response options and summing the responses. This scale was then dichotomised to indicate those scoring one or more points	Alcohol use: AUDIT. Authors used a cutoff of 16 points and above on the AUDIT scale to indicate harmful use

Table 2 (continued)

Author	Assessment measures	Mental health	General health	Cannabis use	Alcohol use
Moffitt et al. [54]	Antisocial behaviour: Rutter Child Scale (11-item antisocial scale) completed by parents and teachers when child was 5, 7, 9, 11	Psychopathology: the mental health assessment was a 50-min module using the Diagnostic interview schedule for DSM-IV disorders with a reporting period of 12 months. Authors classified disorders in anxiety disorders, social phobia, post-traumatic stress disorder, major depression, schizophreniform disorder		Alcohol dependence, other drugs dependence (requiring physiological criteria for withdrawal and tolerance)	Alcohol dependence, other drugs dependence (requiring physiological criteria for withdrawal and tolerance)
Moffitt et al. [19]	Antisocial behaviour: Rutter Child Scale (11-item antisocial scale) completed by parents and teachers when child was 5, 7, 9, 11 (more details in Moffitt et al. 1993) In mid-adolescence authors used self-reported Delinquency Structured Interview (vandalism, shoplifting, buying or selling stolen goods, selling marijuana, drunk driving, beating a family member, beating a non-family member)		WHO sexuality instrument. Unsafe sexual behaviour was considered if the participant had had sexual intercourse with three or more different partners in the last 12 months and never used a condom	DSM-III diagnosis given using the Diagnostic Interview Schedule	DSM-III diagnosis given using the Diagnostic Interview Schedule
Odgers et al. [4]	Conduct problems symptoms (6 key symptoms): physical fight, bullying others, destroying property, telling lies, truancy, and stealing	Mental health: psychiatric disorders (Diagnostic Interview Schedule was used and diagnoses over past year were made according to DSM-IV criteria), suicide attempts (using Life History Calendar), informant reports of internalising symptoms and substance use, informant reports of substance use problems		Diagnostic Interview Schedule for DSM-IV	Diagnostic Interview Schedule for DSM-IV

Table 2 (continued)

Author	Assessment measures	Mental health	General health	Cannabis use	Alcohol use
Odgers et al. [17]	Conduct problems symptoms (6 key symptoms): physical fight, bullying others, destroying property, telling lies, truancy, and stealing	Psychiatric disorders assessed using Diagnostic Interview Schedule (GAD, OCD, phobias, MDD, cannabis and other drugs dependence, PTSD) Indicators of mental health: study members reported whether they had a history of outpatient treatment for mental health or substance abuse, periods when they had psychiatric medication, periods of homelessness, and suicide attempts	Physical health outcomes at age 32: study members provided reports of their overall health on a 5-point Likert scale	Diagnostic Interview Schedule for DSM-IV	Diagnostic Interview Schedule for DSM-IV
Moffitt et al. [19]	Age: grades 1, 2, 3, 6, and age 16: teacher-reported (TRF) CBCL Parent versions and youth (YSR) versions at age 16	CBCL (Young Adult Self-Report, YSR)		Young Adult Health Survey (frequency of substance use)	Young Adult Health Survey (frequency of substance use, risk-taking behaviour, various forms of antisocial behaviour)
Xie et al. [22]	Interpersonal competence scale—teacher administered (which assesses aggression, popularity, and academic competence)				
Hayatbakhsh et al. [55]	Externalising behaviour subscale of CBCL (age 5) and Youth Self Report version of CBCL (age 14)			Cannabis use assessed using CIDI-Auto (age 21)	Cannabis use assessed using CIDI-Auto (age 21)
Stringaris et al. [56]	Mother-reported SDQ (conduct problems subscale)	Depression assessed using the Revised Clinical Interview Scale (CIS-R), a self-administered computerised interview administered at age 18			

Author	Assessment measures	Mental health	General health	Cannabis use	Alcohol use
McGee et al. [57]	CBCL (aggression scale, completed by mother) administered at age 5 and the externalising scale of YSR (self-reported version of CBCL) at age 14	Young adult anxiety and depression were assessed using the 17-item anxiety and depression subscale of Young Adult Self-Report (YASR) version of the CBCL	General health was assessed by asking participants whether they had ever been told by a doctor that they had any of the following health problems: diabetes, hypertension, eczema, asthma, depression, anxiety disorder, autism, schizophrenia, migraine, tension headache, attention deficit hyperactivity disorder, liver disease, gall bladder disease, and/or obstructive sleep apnoea		
Sentse et al. [25]	Dutch version of CBCL	Youth self-report (YSR). Syndrome scores were created for anxious/depressed, withdrawn/depressed, thought problems, attention problems	YSR: somatic complaints		

CBCL child behavior checklist, *TRF* Teacher-reported form, *YSR* Young person Self-report, *PDI* Peters delusion inventory, *SDQ* Strengths and Difficulty Questionnaire, *DSM* diagnostic and statistical manual of mental disorders, *GAD* generalised anxiety disorder, *MDD* major depressive disorder, *ODD* obsessive-compulsive disorder, *PTSD* post-traumatic stress disorder, *CIS-R* Clinical Interview Scale Revised

Six studies examined education outcome (poor education). We observed the largest effect size for the EOP trajectory (pooled OR 4.14, 95% CI 1.95–8.82). Also AO and CL individuals were found to be at significantly higher risk of having poor education outcome in young adulthood (pooled OR 2.35, 95% CI 1.44–3.82 and 1.83, 95% CI 1.26–2.65, respectively).

Five studies examined poor occupational outcome (or poor employment outcome). Here, the largest effect size was observed for the EOP trajectory (pooled OR 2.00, 95% CI 1.43–2.79). AO and CL showed a trend towards having a poorer employment outcome, but we did not observe statistical significance (pooled OR 1.22, 95%, CI = 0.95–1.55 and 1.14, 95% CI 0.90–1.45, respectively).

Across all meta-analyses, we observed a poorer outcome in individuals belonging to EOP and AO trajectory compared to individuals in the low trajectory, with EOP individuals usually showing the highest risk (apart from cannabis use and general health, where the risk was slightly lower compared to AO individuals); for these two trajectories, all pooled ORs were statistically significant, with the only exception being for poor employment outcome in the AO group. CL individuals showed a trend towards being at higher risk of poor psychosocial outcomes compared to those in the low group. However, statistical significance was reached only in self-reported aggression and poor education.

When comparing conduct problems trajectories, the EOP was not found to be at significantly increased risk compared to the AO on any of the outcomes considered. However, EOP individuals showed significantly higher risk than CL on mental health, cannabis use, self-reported aggression, official records of criminal behaviour, and poor employment outcome. The AO conferred significant risk compared to the CL only for cannabis use in early adulthood.

Discussion

Our systematic review of evidence from longitudinal studies of health, mental health, and educational and social outcomes associated with conduct problems trajectories suggests that EOP, AO, and CL were associated with poorer outcomes compared to the low trajectory. Yet, we identified a consistent “hierarchy of risk” amongst the trajectories. We found that the trajectory at highest risk of poor outcomes in adulthood is the EOP trajectory, with the highest or equal highest ORs across nearly all outcomes studied. For poor employment outcomes, the EOP was the only trajectory to have significantly higher risk than the Low, but a similar trend was observed in the AO and CL groups too. The AO trajectory had an intermediate risk across most outcomes, with significantly higher risk of poor outcome compared to the low trajectory across seven of eight outcomes (poor

Table 3 Summary of conduct, educational, and social outcome measures

Author	Assessments measures	Self-reported aggression	Criminal records	Education	Employment
Alink and Egeland [35]	CBCL, Teacher Report Form (TRF) and Youth Self-Report (YSR), TRF				Unemployment at age 26. Interview about work and education. One of the questions concerned whether and for how many months the participant had been unemployed during the past three years. Score was based on number of months of unemployment
Bor et al. [53]	CBCL (short form at age 5), while the Youth Self Report CBCL was used at age 14	Youth Adult Self Report of CBCL	Court attendance: yes/no		
Kretschmer et al. [24]	Mother-reported conduct problems, using the “conduct problems” subscale of the SDQ. The sum score was dichotomised using the standard threshold of scores of 4 or more, yielding 6 binary indicators for the latent growth classes	Items similar to the core offenses in the 2005 Offending, Crime, and Justice Survey (mugging, shoplifting, break and enter, selling drugs, fire setting, selling or buying stolen goods) were presented to respondents who indicated whether or not they had engaged in these behaviours in the past year. A score of one was assigned following a positive response to one or more of the items	Respondents indicated whether they had been arrested or convicted of a criminal offense, put on trial in court, got police caution, got court fine, got community service order, received an ASBO (antisocial behaviour order). A score of one was assigned following a positive response to one or more of the items		
Moffitt et al. [54]	Antisocial behaviour: Rutter Child Scale (11-item antisocial scale) completed by parents and teachers when child was 5, 7, 9, 11		Criminal offending (mean number of convictions)	Education completed	Mean months unemployed

Table 3 (continued)

Author	Assessments measures	Self-reported aggression	Criminal records	Education	Employment
Moffitt et al. [19]	Antisocial behaviour: Rutter Child Scale (11-item antisocial scale) completed by parents and teachers when child was 5, 7, 9, 11 (more details in Moffitt et al. 1993) In mid-adolescence the self-reported Delinquency Structured Interview was used (vandalism, shoplifting, buying or selling stolen goods, selling marijuana, drunk driving, beating a family member, beating a non-family member)		Criminal offending (mean number of convictions)	Age when participant left high school	
Odgers et al. [4]	Conduct problems symptoms (6 key symptoms): physical fight, bullying others, destroying property, telling lies, truancy, and stealing	Violence towards others, partner abuse (measured using a standardized interview with 13 physical abuse acts such as hitting, slapping, or kicking and 13 controlling abuse acts such as stalking or stopping contacts with friends or family), hitting a child (measured using the Self-Report Crime Interview), self-reported violence in the past year (using the US national Youth Survey Self-Report Crime Interview), informant-reported fighting	Official violence convictions using the computerised New Zealand Police database. Convictions included, but were not limited to: common assault, rape, indecent assault of a female, robbery, and arson	No educational qualification obtained	Economic problems: SES. Household income, unemployed, informant-rated financial problems, no money for food or other necessities, homeless/taken

Table 3 (continued)

Author	Assessments measures	Self-reported aggression	Criminal records	Education	Employment
Odgers et al. [17]	Conduct problems symptoms (6 key symptoms): physical fight, bullying others, destroying property, telling lies, truancy, and stealing	Violence towards others, partner abuse (measured using a standardized interview with 13 physical abuse acts such as hitting, slapping, or kicking and 13 controlling abuse acts such as stalking or stopping contacts with friends or family), hitting a child (measured using the Self-Report Crime Interview), self-reported violence in the past year (using the US national Youth Survey Self-Report Crime Interview), informant-reported fighting	Official violence convictions using the computerised New Zealand Police database. Convictions included, but were not limited to: common assault, rape, indecent assault of a female, robbery, and arson		
Roisman et al. [45]	Age: grades 1, 2, 3, 6, and age 16: teacher-reported (TRF) CBCL Parent versions and youth (YSR) versions at age 16	CBCL (Young Adult Self-Report, YASR)		School/work status: self-rated, educational attainment. At age 23, participants indicated how far they had gone in school (0 = no degree, 1 = graduate equivalent degree, 2 = high school diploma, 3 = technical school degree, 4 = 2-year degree, 5 = 4-year degree, 6 = post-graduate degree)	Individuals rated at the high end of the scale spent the “dominant pattern” no less than 75% of the time, since they turned 21 in fulltime work, school, or a combination thereof. Participants rated at the middle of the scale were engaged in some combination of part-time work or school for the dominant pattern of the year. Those rated at the low end reported little or no work experience. This rating—as well as the work ethic scale described below—was independently rated by one of two coders, both of whom were trained graduate students or staff on the Parent–Child Research Project
Xie et al. [22]	Interpersonal competence scale—teacher administered (which assesses aggression, popularity, and academic competence)		Criminal arrest in early 20 s	Education failure (between age 20 and 24), defined as not completing high school or an equivalent degree	

Author	Assessments measures	Self-reported aggression	Criminal records	Education	Employment
Hayatbakhsh et al. [55]	Externalising behaviour subscale of CBCL (age 5) and Youth Self Report version of CBCL (age 14)				
Stringaris et al. [56]	Mother-reported SDQ was used (conduct problems subscale)				
McGee et al. [57]	CBCL (aggression scale, completed by mother) administered at age 5 and the externalising scale of YSR (which is a self-reported version of CBCL) at age 14				Young adults were asked whether they had a “paid job” at the time the survey was conducted. They were grouped into the categories paid job (76.6%) and no paid job (23.4%)
Sentse et al. [25]	Dutch version of CBCL	Aggressive behaviour, rule-breaking behaviour (using CBCL YSR)			

CBCL child behavior checklist, TRF Teacher-reported form, YSR Young person self-report, SDQ Strengths and Difficulty Questionnaire, SES socioeconomic status

employment being the exception). The CL trajectory had the lowest ORs across all outcomes compared to the EOP and AO trajectories. CL individuals were at significantly higher risk of poor outcome compared to those in the low trajectory on self-reported aggression and poor educational outcomes. Highest ORs across trajectories were observed for self-reported aggression and poor educational outcomes. Given the interconnectedness of the outcomes considered, it is not surprising to see a trend across domains. Our findings suggest that age of onset of conduct problems alone is not a strong predictor of outcomes, given that the highest and lowest risk trajectories are both childhood-onset, and that the course of conduct problems across childhood and adolescence is most predictive of later outcomes.

Our finding that the EOP trajectory had the highest risk of poor early adult outcomes is consistent with previous reports. It has been posited [19] that EOP individuals differ from AO individuals in terms of negative predisposing genetic factors and early neurocognitive characteristics. More recent studies have also shown that these individuals present with increased levels of environmental risk factors in prenatal stages [13] and early age [36]. A potential explanation for the EOP’s negative outcomes across several domains is that genetic and environmental factors (which are likely to increase vulnerability for long-term psychiatry/physical morbidity independently) interact to maximise risk of developmental snares occurring across several stages of life—particularly adolescence. These developmental snares decrease the likelihood for these individuals to “recover” and shift to a more functional and adaptive course of development. We speculate that the interaction between predisposing genetic factors and negative environmental conditions is particularly relevant for explaining not only the continuity of violent and antisocial acts, but also the variety of difficulties observed across several domains examined here.

In contrast, our finding that AO individuals were at higher risk of poor outcomes compared to those in the low trajectory conflicts with reports that problem behaviour in adolescence is a transient and relatively normative phenomenon [2]. In this group, we also observed higher risk of self-reported aggressive behaviour and official records of antisocial behaviour. This finding contrasts the notion that AO individuals tend to be on the non-aggressive spectrum. They, however, showed lower risk on these outcomes compared to EOP, in line with the previous research [37]. Given the lack of data regarding long-term outcomes of AO individuals, we suggest that the interchangeable use of “Adolescent-Limited” and “Adolescent-Onset” may require careful consideration.

We found the CL trajectory to have the least negative outcomes compared to the EOP and AO trajectories, although those in this group had significantly poorer educational outcomes and problems with aggression in early adult life

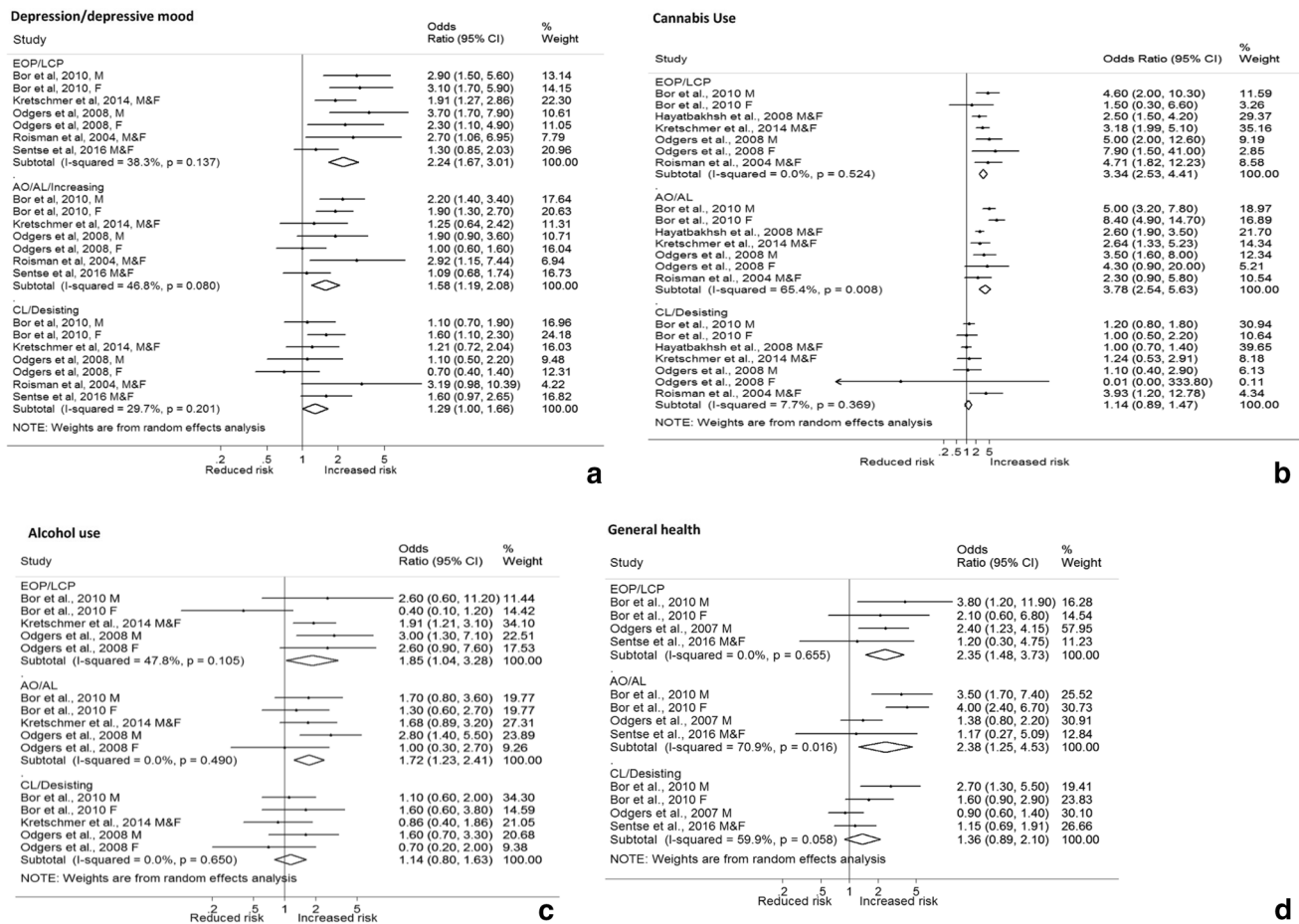


Fig. 2 Forest plots showing individual and overall odds ratios for poor **a** mental health (depression or depressive mood), **b** cannabis use, **c** alcohol use, and **d** poor general health outcome in young adult-

hood for the three conduct problems trajectories compared to the reference category “low” (not shown in the figures)

compared to those in the low trajectory. We note that ORs for other outcomes were in the same direction and of a similar order to other conduct problems trajectories, although they did not reach significance. Our findings support suggestions that full recovery from conduct problems rarely occurs [2] and contradict the notion that CL individuals should be indistinguishable from typical individuals in adulthood [21]. Some have suggested that the decrease in problem behaviours in CL youth may occur in parallel with the development of “off-putting” personality characteristics, such as social awkwardness and social anxiety [17]. Our results do not support this hypothesis, in that CL individuals were not at higher risk of internalising problems compared to the EOP or AO trajectories examined in the present work. Instead, our findings may be partially explained by the suggestion that CL youth have lower levels of environmental difficulties (i.e., family adversity, receiving adequate school support, etc.) and, more importantly, higher levels of effortful control. The interaction between these factors may decrease

internalising problems (perhaps via good levels of peer support) [13, 21]. We have not tested this hypothesis directly but given the importance of understanding causal factors underlying changes in aggressive behaviour, we advocate further investigation.

While we did include conduct disorder as a search term, all studies identified were non-clinical observational studies that relied on reports of conduct problem behaviours. Although the measures that these studies used, including the CBCL [38] and SDQ [39], are predictive of CD and other clinical diagnoses [40, 41], the conduct problems trajectories themselves are not clinical. That said, research has nonetheless been able to show that conduct problems trajectories associate with real-life outcomes, especially for EOP youth. In fact, it has been suggested [41–44] that early, sustained, and assiduous intervention should be warranted for those who display behavioural problems in early age. By doing so, we could prevent these individuals from persisting and

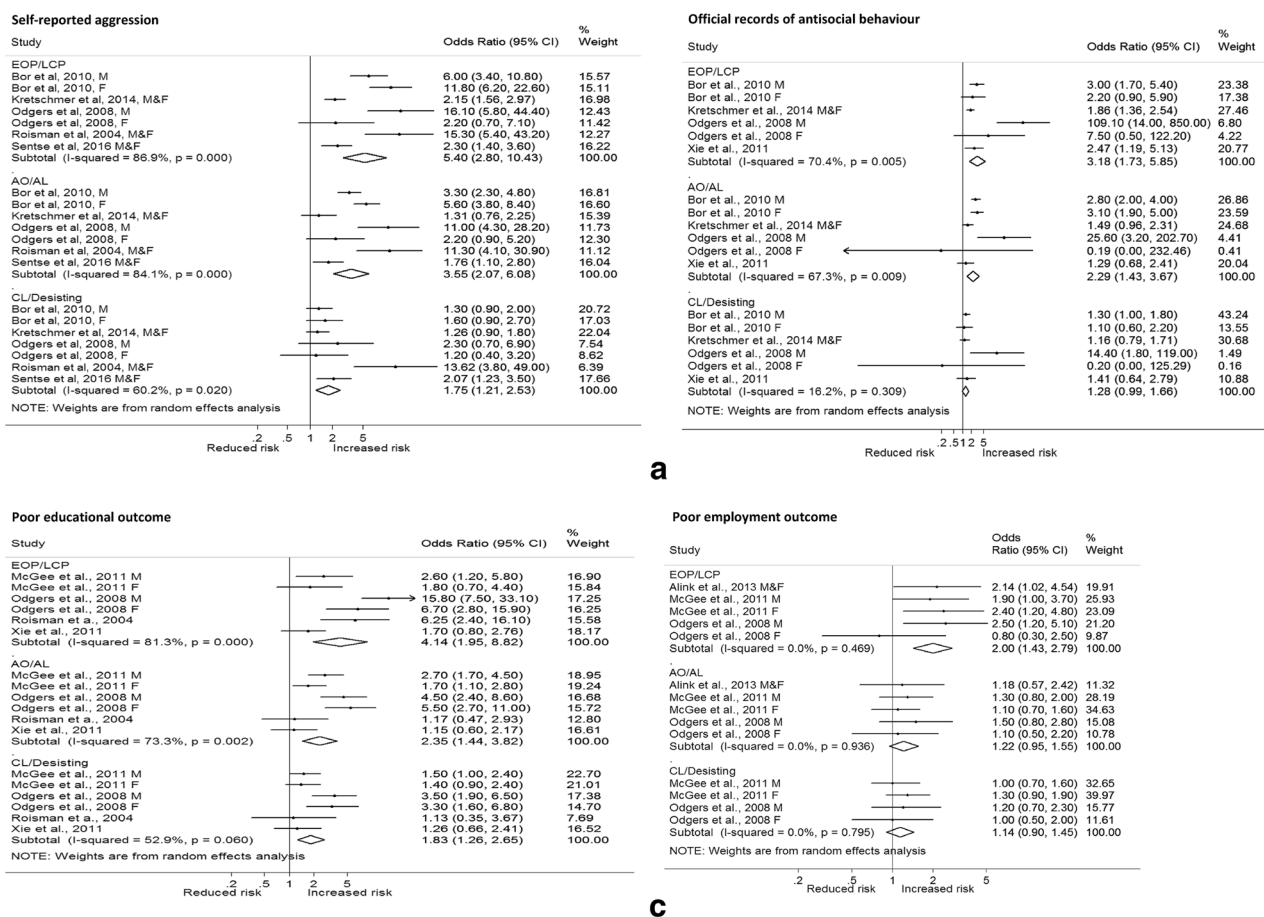


Fig. 3 Forest plots showing individual and overall odds ratios for **a** self-reported aggression, **b** official records of criminal behaviour, **c** poor education, and **d** poor employment outcome in young adulthood

perhaps limit them to stay within a CL trajectory, with consequent adult outcome improvement.

In the present study we have shown that the impact of behavioural problems in childhood and adolescence can be seen in early adulthood/adulthood across several interconnected domains of life. This highlights the urgency for intervention in conduct problems children and adolescents. Combined with data coming from research on predisposing factors of developmental course of conduct problems [45, 46] which suggest that risk factors may be found at multiple levels, we speculate that multi-systemic (i.e., school and family) interventions may be most effective [47].

Strengths and limitations

To our knowledge, this is the first systematic review investigating the adult outcomes of conduct problems trajectories. We considered a wide range of health, social, and educational outcomes, and found consistency in categorisation of conduct problems trajectories across all studies.

for the three conduct problems trajectories compared to the reference category “low” (not shown in the figures)

Several limitations apply to this review. Though trajectories were comparable across studies, we acknowledge that the methods used to derive these trajectories differed, with some studies using two time points and others applying general growth mixture models. In addition, we acknowledge that growth mixture models have limitations, which include over-fitting the number of trajectories [48] which can lead to biased estimates of covariate effects (i.e., outcomes of trajectories) [7]. Furthermore, the measures used to construct these trajectories differed across studies (i.e., different versions of the SDQ or CBCL, or other teacher-reported measures) resulting in some degree of measurement inconsistency. We accept that the most reliable source of data should include multiple informants, and this was not often available in the studies identified for inclusion.

Similarly, outcome measurement slightly differed across studies within each meta-analysis, and this might be the reason for high heterogeneity in a number of cases. Due to small number of studies included in our meta-analyses, we decided not to run a sensitivity analysis to explore heterogeneity as

Table 4 Summary of results for each meta-analysis

Outcome	Trajectories	No. of studies	Pooled OR (95% CI)	I-squared (<i>p</i> value)
Mental health (depression)		7		
	Low		1	
	EOP		2.24 (1.67–3.01)	38.3% (0.137)
	AO/AL		1.58 (1.19–2.08)	46.8% (0.080)
	CL/desisting		1.29 (1.00–1.66)	29.7% (0.201)
Cannabis use		7		
	Low		1	
	EOP		3.34 (2.53–4.41)	0.0% (0.524)
	AO/AL		3.78 (2.54–5.63)	65.4% (0.008)
	CL/desisting		1.14 (0.89–1.47)	7.7% (0.369)
Alcohol use		5		
	Low		1	
	EOP		1.85 (1.04–3.28)	47.8% (0.105)
	AO/AL		1.72 (1.23–2.41)	0% (0.490)
	CL/desisting		1.14 (0.80–1.63)	0% (0.650)
Self-reported aggression		7		
	Low		1	
	EOP		5.40 (2.80–10.43)	86.9% (< 0.000)
	AO/AL		3.55 (2.07–6.08)	84.1% (< 0.000)
	CL/desisting		1.75 (1.21–2.53)	60.2% (0.020)
Criminal behaviour		6		
	Low		1	
	EOP		3.18 (1.73–5.85)	70.4% (0.005)
	AO/AL		2.29 (1.43–3.67)	67.3% (0.009)
	CL/desisting		1.28 (0.99–1.66)	16.2% (0.309)
General health		4		
	Low		1	
	EOP		2.35 (1.48–3.73)	0% (0.655)
	AO/AL		2.38 (1.25–4.53)	70.9% (0.016)
	CL/desisting		1.36 (0.89–2.10)	59.9% (0.058)
Poor education		6		
	Low		1	
	EOP		4.14 (1.95–8.82)	81.3% (< 0.000)
	AO/AL		2.35 (1.44–3.82)	73.3% (0.002)
	CL/desisting		1.83 (1.26–2.65)	52.9% (0.060)
Poor employment outcome		5		
	Low		1	
	EOP		2.00 (1.43–2.79)	0% (0.469)
	AO/AL		1.22 (0.95–1.55)	0% (0.936)
	CL/desisting		1.14 (0.90–1.45)	0% (0.795)

EOP early onset persistent, *AO/AL* adolescent-limited or adolescent-onset, *CL* childhood-limited

suggested by Cochrane Handbook for Systematic Reviews of Interventions [49]. It should be noted, however, that I-squared fell well within the acceptable limits, i.e., $\leq 60\%$ [50] in the majority of meta-analyses. In addition, a 95% confidence interval for the I-squared was not available for those studies where heterogeneity was high: this prevents

us from concluding that heterogeneity was in effect falling outside acceptable limits [51].

We also acknowledge that the age of outcome in the studies which we identified was quite low (mean age 22.5). It could be argued that this may have resulted in outcomes being particularly negative for AO individuals, due to the

relatively short gap between onset of behavioural problems and outcome measurement. However, ORs for AO individuals did not decrease in size when we conducted the meta-analyses without those studies with very early age at outcome (i.e., age 17 or 18), but slightly increased (results available in supplemental information). Our review has examined relatively early outcomes/correlates: future research should focus on long-term outcomes associated with different conduct problems trajectories, beyond early adulthood.

Although the majority of studies adjusted for factors such as socioeconomic status, gender, and other variables that usually associated with mental health, a minority did not provide adjusted summary statistics requiring the use of unadjusted effect sizes.

To conclude, all trajectories of conduct problems were associated with poorer outcomes in several psychosocial domains when compared to individuals without conduct problems, particularly those belonging to the EOP trajectory. AO individuals were at intermediate risk and CL individuals at least risk. When compared to CL, EOP individuals were still showing higher risk on poor mental health, cannabis use, self-reported aggression, official records of criminal behaviour, and poor employment. To investigate whether the same pattern of results is observed later on in life, future research should make use of longitudinal data sets with a wider age span. In addition, work should focus on integrating multiple conduct problems subtype categories (presence/absence of callous-unemotional traits and physical aggression vs rule-breaking) to better understand and predict the development and outcome of young people with conduct problems, given that age of onset is only one way of classifying conduct problems [52]. Being able to identify those at higher risk of poor psychosocial outcome will help guide and allocate prevention and intervention programs more effectively.

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Compliance with ethical standards

Conflict of interest All authors have disclosed that they have no competing or potential conflicts of interest.

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Appendix

Search strategy

PsycINFO:

1. exp Conduct Disorder/
2. conduct disorder*.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]
3. conduct problem*.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]
4. 2 or 3
5. 1 or 4
6. drug abuse/
7. (antisocial behaviour or substance-related disorder\$ or substance use\$ or substance abuse or outcome\$ or anti-social personality disorder).mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]
8. exp Antisocial Personality Disorder/
9. 6 or 7 or 8
10. exp Longitudinal Studies/
11. (trajector\$ or developmental or childhood or pathway\$ or longitudinal or prospective or continuity or follow-up or consequence\$ or developmental or pathway or longitudinal or early onset or late onset or adolescent-onset or childhood-onset or age of onset or adult or continuity or follow-up or consequence or adulthood or prospective).mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]
12. 10 or 11
13. 9 or 12
14. 5 and 13

MEDLINE:

("Substance-Related Disorders"[Mesh]) OR "Antisocial Personality Disorder"[Mesh] OR antisocial behavior OR antisocial behaviour OR substance-related disorder* OR substance use OR substance abuse OR outcome* OR antisocial personality disorder)) OR (("Longitudinal Studies"[Mesh]) OR "Prospective Studies"[Mesh] OR trajector* OR developmental OR pathway* OR longitudinal OR prospective OR continuity OR follow-up OR consequence*)) AND ("Conduct Disorder"[Mesh] OR conduct disorder* OR conduct problem*)

Newcastle–Ottawa Scale (amended version)

Note: A study can be awarded a maximum of one star for each numbered item within the Selection and Outcome categories. A maximum of two stars can be given for Comparability.

Selection

1. Representativeness of the exposed cohort
 - (a) truly or somewhat representative of the average conduct problems trajectory in the community ★
 - (b) selected group, unrepresentative of the total group (i.e., prison sample)
 - (c) no description of the derivation of the cohort
2. Selection of the non-exposed (Low trajectory)
 - (a) drawn from the same community as the exposed cohort ★
 - (b) drawn from a different source ●
 - (c) no description of the derivation of the non-exposed cohort
3. Ascertainment of exposure
 - (a) Use of validated tools at different time points ★
 - (b) self/maternal/other report (non-standardized) or retrospective recollection
 - (c) no description

Comparability

1. Comparability of cohorts on the basis of the design or analysis ●
 - (a) study controls for any of gender, SES, ethnicity, and other factors usually associated with mental health ★
 - (b) study controls for any other factors ★
 - (c) no mention of control variables

Attrition

1. Adequacy of follow-up of cohorts
 - a. less than 20% attrition, or description provided of those lost ★
 - b. follow-up rate less than 80% and no description of those lost
 - c. no statement

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